

OVERHEAD PACKAGING CUSHION SUPPLY SYSTEM

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BACKGROUND OF THE INVENTION

The present invention relates to systems for providing packaging cushions to a hopper.

Packaging dunnage material may be used to fill the void spaces in a box containing a packaged article. One type of packaging dunnage material is air-filled dunnage
10 cushions, which may be provided as a string of air-filled cushions with perforations between cushions. The packer selects the desired number of cushions to be inserted as dunnage in the box, and manually tears the perforations to separate a selected section of cushions from the string.

Businesses that package and ship numerous articles may have several packing
15 stations at which packers insert the dunnage cushions in boxes along with the articles to be packaged. The plant space at which this packaging occurs may be cramped because of the equipment and materials used to deliver, package, and ship the articles.

SUMMARY OF THE INVENTION

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The present invention may address one or more of the aforementioned problems. A system for supplying packaging cushions manufactured from cushion feedstock comprises a lift, a cushion-supply machine moveably supported by the lift, and a hopper. The hopper defines an entrance opening for receiving packaging cushions from the cushion-supply machine into the hopper, and an exit opening for withdrawing cushions from the hopper. The elevation of the
25 hopper entrance opening is higher than the elevation of the hopper exit opening. The cushion-supply machine is capable of manufacturing packaging cushions from cushion feedstock. The cushion-supply machine defines a cushion outlet. The lift is adapted to move the cushion-supply machine between a supply position, in which the elevation of the cushion outlet is higher than the elevation of the hopper entrance opening, and a reload position, in which the elevation of the

cushion-supply machine cushion outlet is lower than the elevation of the hopper entrance opening.

These and other objects, advantages, and features of the invention will be more readily understood and appreciated by reference to the detailed description of the invention and the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a representational perspective view of one embodiment of a packaging cushion supply system of the present invention comprising a jackscrew lift and having the cushion-supply machine in the supply position;

FIG. 2 is a representational perspective view of the packaging cushion supply system of Figure 1 having the cushion-supply machine in the reload position;

FIG. 3 is a representational partial sectional view taken along the line 3-3 of Figure 1;

FIG. 4 is a representational partial sectional view taken along the line 4-4 of Figure 1;

FIG. 5 is a representational perspective view of another embodiment of the present invention comprising a hydraulic lift and the cushion-supply machine in the reload position a representational partial sectional view taken along the line 5-5 of Figure 2;

FIG. 6 is a representational partial sectional view taken along the line 6-6 of Figure 2;

FIG. 7 is a representational perspective view of another embodiment of the present invention having the hopper completely supported by the lift, showing by dark lines the cushion-supply machine in the reload position, and by phantom lines the cushion-supply machine in the supply position;

FIG. 8 is a representational perspective view of another embodiment comprising a hoist lift, showing by dark lines the cushion-supply machine in the reload position, and by phantom lines the cushion-supply machine in the supply position;

FIG. 9 is a representational partial sectional view taken along the line 9-9 of Figure 8;

FIG. 10 is a representational perspective view of another embodiment comprising a hydraulic lift and the cushion-supply machine in the reload position; and

FIG. 11 is a representational perspective view of the embodiment of Figure 10 showing the lift in the extended position and the cushion-supply machine in the supply position.

Like elements in different drawings may use the same reference number.

DETAILED DESCRIPTION OF THE INVENTION

A system 10 for providing packaging cushions may comprise a cushion-supply machine 20, a lift 22, and a hopper 24.

Cushion-Supply Machine

Cushion-supply machine 20 is capable of manufacturing cushions 26 from cushion feedstock 28. The cushions 26 may be in the form of a string of packaging cushions 30, in which each cushion 26 of the string of packaging cushions 30 is connected to at least one other adjoining cushion of the string. The string of packaging cushions 30 may include perforations 32 (Figs. 3-4) between adjacent cushions 26 of the string 30 to facilitate separation of the string into string segments or into one or more individual cushions. "Perforations" as used herein includes scoring or other lines of weakening adapted for the purpose of facilitating separation of the string of packaging cushions. The string of packaging cushions 30 may comprise air-filled cushions, foam-filled cushions, as well as cushions comprising other types of packaging materials. Such cushions may be useful in or adapted for packaging dunnage applications. An exemplary string of air-filled dunnage cushions is sold under the Fill-Air 1000® trademark by Sealed Air Corporation.

Cushion-supply machine 20 defines a cushion outlet 34, which is the site at which the creation of each new cushion 26 (e.g., in string of packaging cushions 30) is completed by machine 20. Machine 20 may comprise feedstock holder 36, which may be adapted to support an inventory of cushion feedstock 28 as the feedstock is converted by machine 20 into cushions 26. Such an inventory of cushion feedstock may be in roll form, as illustrated. The cushion feedstock 28 may comprise a flexible film or web configuration. The film may be monolayer or multilayer and may be made, for example, by thermoplastic extrusion or coextrusion processes.

The cushion feedstock 28 may comprise one or a plurality of pre-formed, partially completed cushions. The cushion feedstock may comprise a film folded over on itself (e.g., centerfolded) in a lengthwise direction to establish top and bottom films, and/or may comprise separate top and bottom films sealed together along one edge in the lengthwise (i.e., machine) direction. The cushion feedstock may comprise top and bottom films having a plurality of transverse seals adhering the top and bottom films together to pre-establish at least a portion of the peripheral boundaries that will define cushion 26 upon its completion.

Cushion feedstock 28 may comprise any flexible material that may be manipulated by cushion-supply machine 20 to form cushions 26. The feedstock may comprise one or more thermoplastic materials, for example, one or more of polyethylene homopolymers, polyethylene copolymers, polypropylene homopolymers, and polypropylene copolymers (e.g., propylene/ethylene copolymer), polyesters, polystyrenes, polyamides, and polycarbonates. Useful polyethylene homopolymers include low density polyethylene (LDPE) and high density polyethylene (HDPE). Useful polyethylene copolymers include ionomers, EVA, EMA, heterogeneous (e.g., Zeigler-Natta catalyzed) ethylene/alpha-olefin copolymers, and homogeneous (e.g., metallocene, single-site catalyzed) ethylene/alpha-olefin copolymers. Ethylene/alpha-olefin copolymers are copolymers of ethylene with one or more comonomers selected from C3 to C20 alpha-olefins, such as 1-butene, 1-pentene, 1-hexene, 1-octene, methyl pentene, in which the polymer molecules comprise long chains with relatively few side chain branches, including linear low density polyethylene (LLDPE), linear medium density polyethylene (LMDPE), very low density polyethylene (VLDPE), and ultra-low density polyethylene (ULDPE).

Machines for manufacturing cushions are known in the art. An exemplary cushion-supply machine 20 for manufacturing a string of packaging cushions 30 is the Fill-Air 1000® machine available from Sealed Air Corporation. Further examples of cushion feedstock, strings of packaging cushions, and cushion-supply machines are disclosed in U.S. Patents 5,942,076 to Salerno; 6,460,313 to Cooper; 6,582,800 to Fuss et al; 6,598,373 to Sperry et al; 6,605,169 to Perkins et al; 6,651,406 to Sperry et al; and 6,659,150 to Perkins et al; each of which is incorporated herein in its entirety by reference.

Lift

The lift 22 moveably supports the cushion-supply machine 20. The lift 22 is adapted to move the cushion-supply machine 20 between a supply position 38 (Figs. 1, 3), in which the elevation of the cushion outlet 34 is higher than the elevation of the hopper entrance opening 42 (discussed below), and a reload position 40, in which the elevation of the cushion outlet 34 is lower than the elevation of the hopper entrance opening 42 (Fig. 2).

In the reload position 40, the feedstock holder 36 may be manually accessible from ground level to replenish or reload an inventory of cushion feedstock 28 onto feedstock holder 36. For example, in the reload position 40, the feedstock holder may be less than about any of the following values above ground level: 7 feet, 6 feet, 5 feet, and four feet. Further, the elevation of cushion outlet 34 when the cushion-supply machine 20 is in the reload position 40 may be lower than the elevation of the cushion outlet 34 when machine 20 is in the supply position 38 by at least about any of the following values: 5 feet, 6 feet, 7 feet, 8 feet, 10 feet, 12 feet, and 15 feet. Also, the elevation of the cushion supply outlet 34 in the reload position 40 may be below the elevation of the hopper exit opening 44 (discussed below).

Lift 22 may comprise any of a jackscrew lift, a hoist lift, and/or a hydraulic lift. In all of the drawings the lift is generally referred to by the numbering "lift 22" without regard to which of the mechanical principles upon which the lift is based or configured (e.g., jackscrew, hoist, hydraulics). Generally, a jackscrew lift may utilize a screw or threaded gear arrangement to raise and lower a load; a hoist lift may utilize one or more cables, ropes, chains, or lines in conjunction with one or more pulleys and/or counterweights to raise and lower a load, for example, in a block and tackle configuration or roped elevator configuration; and a hydraulic lift may utilize one or more hydraulic piston systems to raise and lower a load.

An exemplary jackscrew lift embodiment of lift 22 is illustrated in Figures 1-7; an exemplary hoist lift embodiment is illustrated in Figures 8-9; and an exemplary hydraulic lift embodiment is illustrated in Figures 10-11. Similar elements in each embodiment may be identified by the same number.

Jackscrew Lift

Turning to a jackscrew lift embodiment (Figs. 1-7), lift 22 may comprise lift base 46 supporting tower frame 48 which may extend from lift base 46. Lift base 46 may comprise sufficient weight to support lift 22 in an upright position without attachment to the floor or ground level. Lift base 46 may be affixed to the floor or ground level, for example, by one or more fasteners 50 (e.g., bolts, screws, rivets), as shown in Figure 7.

Tower frame 48 of lift 22 may rotatably support one or more screws 54, such as left screw 56 and right screw 58. The top end of each of left screw 56 and right screw 58 may be rotatably supported at or near the top of left tower 60 and right tower 62, respectively. The bottom end of each of left screw 56 and right screw 58 may be rotatably supported by lift base 46 (as shown) or by the corresponding left or right tower. The left and right screws may be supported at the top so that they are in tension (i.e., so that the screws hang in tension rather than stand in compression). Each of the screws 54 comprise a thread (e.g., a helical rib) extending an effective distance along its length.

The right screw 58 may be rotated, for example, by motor 64 adapted to rotate one or more of screws 54, for example by having first drive chain, belt, or gear arrangement 66 translating rotational energy from the drive shaft 70 of the motor 64 to the driven pulley 68 that may be attached at or near the bottom of right screw 58. The left screw 56 may be rotated, for example, by a second drive chain or belt 72 engaging pulleys 74 and 76, which may be attached to right and left screws 58, 56 respectively, to indirectly translate rotational energy from motor 64 to left screw 56 as right screw 58 rotates.

Lift 22 may comprise platform 90, which may comprise platform frame 78 and platform shelf 88. Platform frame 78 may be supported by one or more of the screws 54. The platform frame 78 may engage the screw and be adapted so that rotation of the screw in a first direction causes the platform 90 to rise and rotation of the screw in a second direction opposite the first direction causes the platform 90 to lower. For example, the screw 54 may be threaded through nut 80 (Fig. 5) that is fixedly attached to platform frame 78 so that the platform frame 78 is supported by the engagement of nut 80 with the threads of screw 54, and rotation of the screw causes nut 80 to raise and lower along the threads of the screw, thereby raising and lowering

platform 90. Platform 90 may also slideably engage the tower frame 48 so that the tower frame may help stabilize and align the platform as it is raised and lowered.

The platform frame 78 may include one or more of lower cross member 82 and upper cross member 84 connected by one or more of tie members 86. The screws 54 extend through the lower and upper cross members 82, 84 of the platform frame 78. As illustrated, right nut 80 may be fixedly attached to the right end of upper cross member 84 and engages right screw 58; nut 81 (Fig. 6) may be fixedly attached to the left end of upper cross member 84 and engage left screw 56 so that the platform may be raised and lowered by both the left and right screws operating in tandem. For example, rotation of the right screw 58 in a first right screw direction may cause the platform frame 78 to raise and rotation of the right screw 58 in a second right screw direction opposite the first right screw direction may cause the platform frame 78 to lower. Also, rotation of the left screw 56 in a first left screw direction may cause the platform frame 78 to raise and rotation of the left screw 56 in a second left screw direction opposite the first left screw direction causes the platform frame 78 to lower.

Although the jackscrew embodiment illustrated in the drawings illustrates a fixed nut with a rotating screw, it is also envisioned that the raising and lowering of the platform may be accomplished by a jackscrew arrangement in which the screw is fixed and the nut rotates. Also, in the embodiments illustrated in the drawings, the lower cross member 82 and the tie members 86 serve to provide structural stability to the platform frame. It is envisioned that the lower cross member could also support one or more nuts to engage the screws 54 either in conjunction with or in lieu of the nuts 80 of the upper cross member 84.

Platform frame 78 may support platform shelf 88 of platform 90. The platform shelf 88, in turn, may support the cushion-supply machine 20, so that the cushion-supply machine 20 is raised and lowered as platform 90 is raised and lowered.

Hoist Lift

Turning to a hoist lift embodiment (Figs. 8-9), lift 22 may comprise lift base 46 supporting tower frame 48 which may extend from lift base 46. Lift base 46 may define one or more fork or pallet jack receptacles 52 (Figure 8), configured to facilitate the receipt of one or

more of the forks of a forklift or the legs of a pallet jack, which may be used in lifting and moving lift 22 during installation.

Lift 22 may comprise one or more cable members 110 moveably supported by tower frame 48 and engaging platform 90. The one or more cable members may be adapted to
5 raise the platform 90 to place the cushion-supply machine in the supply position 38 and to lower the platform 90 to place the cushion-supply machine 20 in the reload position 40.

For example, tower frame 48 may rotatably support one or more upper pulleys 106 at or near the top of left tower 60 and right tower 62, and one or more lower pulleys 108 at or near the bottom of left and right towers 60, 62. The one or more cable members 110 may
10 extend around upper pulleys 106 and lower pulleys 108. Each of the cable members 110 may have a first cable end 112 affixed to platform 90 and a second cable end 114 affixed to platform 90, the second cable end being opposite the first cable end.

Cable member 110 may comprise one or more of cable, rope, chain, wire, or line, for example in twisted or braided configuration. Cable member 110 may comprise metal, such
15 as steel. Cable member 110 may be capable of supporting the weight of platform 90 and any components supported by the platform.

One or more of the lower pulleys or sheaves 108 may be rotated, for example, by motor 64 adapted to rotate the pulleys, for example by having first drive chain, belt, or gear arrangement 66 for translating rotational energy from the motor 64 to the lower pulleys. The
20 lower pulleys or sheaves 108 may be adapted to frictionally engage or grip the cable member 110 as it passes through the pulley in order to move the cable member as the pulley moves and thus also move the platform 90 supported by and affixed to the cable member 110.

Rotation of the lower pulley 108 in a first direction causes the cable member 110 to raise the platform 90 and rotation of the lower pulley a second direction opposite the first
25 direction causes the cable member 110 to lower platform 90. The movement of the platform 90 in turn raises or lowers cushion-supply machine 20 supported by platform 90.

Lift 22 may comprise guide member 116 comprising slot 120 and protrusion 118 that is slideably received by slot 120. Slot 120 may be formed by platform 90. Protrusion 118 may extend along the length of right tower 62. The guide member 116 may be adapted so that

slot 120 and protrusion 118 cooperatively engage each other to reduce or restrict the non-vertical movement of the platform 90 as it is raised and lowered by cable member 110.

Hydraulic Lift

Turning to a hydraulic lift embodiment (Figs. 10-11), lift 22 may comprise lift base 46 supporting one or more hydraulic jacks, for example, left hydraulic jack 122 and right hydraulic jack 124. As is known in the art, a hydraulic jack system comprises a fluid-driven piston mounted inside a cylinder. Each hydraulic jack 122, 124 may comprise a telescoping hydraulic jack system, comprising a series of pistons and cylinders, which are adapted to cooperate to move from a collapsed position 126 (Fig. 10) to an extended position 128 (Fig. 11). The hydraulic cylinders may be in fluid communication with a hydraulic fluid supply system (not shown) to power the lift. The hydraulic fluid supply system may comprise a pump, valve, and hydraulic fluid reservoir (not shown), as are known in the art. One hydraulic fluid system may power both the left and right hydraulic jacks 122, 124.

Each of the hydraulic jacks 122, 124 are adapted to move between an extended position 128 (Fig. 11), to elevate platform 90 and place the cushion-supply machine 20 in the supply position 38, and a collapsed position 126 (Fig. 10), to lower platform 90 and place the cushion-supply machine 20 in the reload position 40. An exemplary hydraulic lift is disclosed in U.S. Patent 5,181,693 to Lorenz, which is incorporated herein in its entirety by reference.

Blower

Blower 92 may be located downstream from the cushion outlet 34 of the cushion-supply machine 20 and upstream from the hopper entrance opening 42. (Figs. 1, 3-4.) Blower 92 may be adapted to provide an airflow 94 to assist movement of the packaging cushions 26 from the cushion outlet 34 to the hopper entrance opening 42. Blower 92 may be supported by platform 90, for example, beneath shelf 88.

The pathway from the cushion outlet 34 to the hopper entrance opening 42 may be unenclosed so that the cushions 26 do not pass through a duct or other fully enclosed member before entering the hopper 24.

Hopper

Hopper 24 is adapted to store packaging cushions 26, for example, string of packaging cushions 30. Hopper 24 may comprise a mesh basket to hold the cushions 26. Hopper 24 defines an entrance opening 42 for receiving packaging cushions 26 from the cushion-supply machine 20 into hopper 24. Hopper 24 also defines one or more exit openings 44 for withdrawing cushions 26 from hopper 24. The elevation of hopper entrance opening 42 is higher than the elevation of the one or more hopper exit openings 44.

Hopper 24 may be elevated above a packing station 96, for example, elevated so that the hopper exit opening 44 is about shoulder height to facilitate access. For example, one or more hopper exit openings 44 may be at least about any of the following distances above ground level: 3 feet, 4 feet, 5 feet, and 6 feet. Packing station 96 may be under hopper 24. (Figs. 1-2.) Conveyor 98 may be under hopper 24. (Fig. 7.)

Hopper 24 may be unsupported by the lift 22, for example, so that the hopper 24 is free standing. Alternatively, hopper 24 may be at least partially supported by the lift 22, for example, portions of hopper 24 may be affixed to the lift by fasteners 100, other portions of hopper 24 may be supported by struts 102 extending from tower frame 48 to hopper 42, and still other portions of hopper 24 may be supported by legs 104 extending from hopper 24 to the ground level. (Figs. 1-4.)

Hopper 24 may be completely supported by the lift 22, for example, so that any support member that bears or supports any significant amount of weight of hopper 24 transfers such weight load to lift 22 (Fig. 7.) For example, portions of hopper 24 may be affixed to the lift by fasteners 100, and/or one or more support members 104 may extend from tower frame 48 to hopper 24. Support members 104 may comprise flexible chain, rope, or cable, or may comprise a relatively inflexible rod or strut.

Controller

Controller 130 may control (e.g., turn on or off) motor 64 or the hydraulic fluid supply system in order to raise and lower lift 22 to a desired position in response to input such as manual input by the operator. Controller 130 may also control the operation (e.g., on/off, speed) of the cushion-supply machine 20. Input/output connections and signal transmission lines

between the controller 130 and the various sensors and controlled devices are not shown but are known to those skilled in the art. Controller 50 may comprise a programmable logic controller ("PLC").

One or more sensors (not shown) may be positioned in conjunction with the hopper 24 to detect whether the level of cushions 26 in the hopper is above or below a desired level. The sensors may send a signal to controller 130 regarding the status (e.g., the full/empty status) of the hopper 24. A sensor may comprise one or more of a photo-eye, an electric-eye, a photo-detector, and a corresponding reflector. Such sensors and their operation are known to those of skill in the art.

Operation

An operator may activate lift 22 to place the cushion-supply machine 20 in the reload position 40. The operator may then load cushion-supply machine 20 with an inventory of cushion feedstock 28, for example, by installing a roll of cushion feedstock onto the feedstock holder 36. The loading step may be accomplished by a person standing at ground level. The operator may then activate lift 22 to place the cushion-supply machine 20 in supply position 38. The operator may then start the cushion-supply machine 20 to convert cushion feedstock 28 into cushions 26, for example string of cushions 30.

The manufactured cushions exit cushion outlet 34 of the machine and feed into hopper 24 through the hopper entrance opening 42. In doing so, the cushions may travel (i.e., by "falling" or by gravity flow) along an unenclosed pathway from the cushion outlet 34 to the hopper entrance opening 42. If the cushions 26 are configured as string of cushions 30, then the later-produced cushions in the string may help push the earlier-produced cushions in the string into the hopper 24. Blower 92 may produce an airflow 94 to help direct the cushions into the hopper 24.

An operator standing proximate packing station 96 may reach to exit opening 44 of hopper 26 to withdraw a desired number of cushions 26 for insertion as dunnage, bracing, or protective material into box 130, along with the product to be packaged. The operator may manually tear the perforations 32 to separate a selected section of cushions from a string of packaging cushions 30.

A sensor (discussed above) installed in hopper 24 may signal controller 130 to automatically stop the cushion-supply machine 20 if the level of cushions 26 in hopper 24 rises above a desired level. Another sensor installed in hopper 24 may signal controller 130 to automatically start the cushion-supply machine 20 if the level of cushions 26 in hopper 24 falls
5 below a desired level.

Once the cushion-supply machine 20 has depleted the inventory of cushion feedstock 28 below a desired level (e.g., runs empty of cushion feedstock), then controller 130 may automatically stop the cushion-supply machine, or the operator may stop the cushion-supply machine, for example, by manually engaging controller 130. The operator may then activate lift
10 22 to place the cushion-supply machine 20 in the reload position 40 so the machine may again be loaded with cushion feedstock 28.

The above descriptions are those of preferred embodiments of the invention. Various alterations and changes can be made without departing from the spirit and broader
15 aspects of the invention as defined in the claims, which are to be interpreted in accordance with the principles of patent law, including the doctrine of equivalents. Except in the claims and the specific examples, or where otherwise expressly indicated, all numerical quantities in this description indicating amounts of material, reaction conditions, use conditions, molecular weights, and/or number of carbon atoms, and the like, are to be understood as modified by the
20 word "about" in describing the broadest scope of the invention. Any reference to an item in the disclosure or to an element in the claim in the singular using the articles "a," "an," "the," or "said" is not to be construed as limiting the item or element to the singular unless expressly so stated. The definitions and disclosures set forth in the present Application control over any inconsistent definitions and disclosures that may exist in an incorporated reference.

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